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Imports, Entry, and Competition Law as Market Disciplines

Hiau Looi Kee
Bernard Hoekman

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Abstract

Since the early 1990s numerous countries have adopted or strengthened competition legislation. Kee and Hoekman investigate the impact of competition law on industry markups over time and across a large number of countries. They find both domestic and foreign competition to be major sources of market discipline in concentrated markets, but that the direct effect of competition law is insignificant. However, once allowance is made for the endogeneity of both domestic competiton (number of firms) and the adoption of a competition law, the authors find that competition laws have an indirect effect on equilibrium markups by promoting a larger number of domestic firms.

This paper—a product of Trade, Development Research Group—is part of a larger effort in the group to study the links between trade and competition policies. Copies of the paper are available free from the World Bank, 1818 H Street NW, Washington, DC 20433. Please contact Paulina Flewitt, room MC3-333, telephone 202-473-2724, fax 202-522-1159, email address pflewitt@worldbank.org. Policy Research Working Papers are also posted on the Web at http://econ.worldbank.org. The authors may be contacted at hlkee@worldbank.org or bhoekman@worldbank.org. April 2003. (30 pages)

Imports, Entry and Competition Law as Market Disciplines[1]

Hiau Looi Kee[2] and Bernard Hoekman[3]

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[2] Development Economics Research Group, The World Bank, 1818 H Street N.W., Washington, DC 20433, USA. E-mail: hlkee@worldbank.org.
[3] Development Research Group, the World Bank, 1818 H Street N.W., Washington, DC 20433, USA, and CEPR, London, UK. E-mail: bhoekman@worldbank.org.

1. Introduction

An important focus of discussions in international fora such as the WTO and the OECD is whether and how to expand the reach of competition legislation across members, strengthen cooperation between national agencies and explore the scope for the adoption of common norms. For example, multilateral dialogue in the WTO is currently focusing on an agreement that members abide by 'core principles' – nondiscrimination, national treatment and transparency (due process) – as well as, possibly, provisions banning 'hard core' cartels (Hoekman and Mavroidis, 2003).

Relatively little cross-country empirical work has been done to identify the effect of competition law on the contestability of markets. For OECD countries this is an interesting research question, but not of major policy significance given that competition enforcement is long established in the main jurisdictions (US, EU, Canada, Japan). For these countries the policy questions revolve around issues such as the appropriate approach to dealing with vertical restraints and merger control. In many developing countries, however, the question is much more fundamental and centers on determining the magnitude of the net benefit of competition law. Adoption of such mechanisms is costly, requiring the allocation of skilled lawyers and economists that are in scarce supply. It may well be that a larger 'bang for the buck' can be obtained through less administratively costly policy measures to increase competition on markets. Of course, trade economists have long argued that trade liberalization is a powerful and administratively very simple way of enhancing competition (Bhagwati, 1968).[4] Other economists have emphasized the importance of removing government created

[4] It is often argued that an open trade regime is a powerful instrument to discipline the behavior of firms which have market power. The empirical literature investigating the impact of import competition on the pricing behavior of domestic firms has concluded that trade liberalization forces firms to set prices closer to marginal costs. That is, there is a negative relationship between price-cost margins (markups) and the openness of the economy. Indeed, Levinsohn (1993), Harrison (1994), Grether (1996) and Djankov and Hoekman (2000) all find some support for the hypothesis that imports are a source of market discipline in

barriers to entry and exit for firms (Djankov et al, 2002).

This paper attempts to determine the relative impact of competition law on competition outcomes. Specifically, we investigate empirically the contribution of competition law relative to alternative types of policies that enhance the contestability of markets, in particular import competition and measures to ease entry and exit of firms. From a policy perspective this analysis is relevant both in terms of informing decision makers on the relative importance of alternative national mechanisms to promote competition, and in terms of identifying where the priority areas for action may lie in terms of international cooperation.

We develop a simple model where the markup by an industry of price over marginal cost is positively related to the size of domestic sales and negatively related to the number of domestic firms that are active in the industry, the magnitude of imports and the demand elasticity of the industry. Industry markups are estimated as a semi-translog function of the number of firms, value of imports and domestic production, using country, year and industry fixed effects to control for the demand elasticity of the industries. Having determined the impact of foreign and domestic competition (the number of domestic firms in an industry), a dummy variable approach is used to capture the impact of the introduction of a competition law.

The results of cross-industry, cross-country, time series regressions using a sample of 28 industries, 42 countries and 18 years indicate that controlling for import competition and the number of firms in each industry/country, competition law has no direct impact on industry markups. These results suggest that from a competition viewpoint, policy priority should be given to measures that directly increase competition on markets - such as trade liberalization or the removal of entry barriers. However, once we control for the endogeneity of competition

studies of domestic firms behavior in Turkey, the Ivory Coast, Mexico, and Bulgaria respectively. For reviews of the literature, see Levinsohn (1996), Roberts and Tybout (1996) and Evenett, Lehmann, and Steil (2000).

law adoption, we also find that industries that operate under a competition law tend to have a larger number of domestic firms, suggesting that in the long run, competition laws may have an indirect effect on domestic industry markups by promoting entry.

This paper is organized as follows. We discuss our empirical model in Section 2, and present the data set in Section 3. Section 4 shows the estimation results, and Section 5 concludes the paper with some policy discussions.

2. Model

One of the biggest difficulties in studying the effectiveness of competition law on industries is to define a measurable outcome variable. Given that the main objective of any competition law is to promote competition, variables that capture the level of competition, or the market power of firms in the industries are natural candidates. One such variable is the markup of price over marginal cost of production by firms in an industry.[5] In perfect competition, price equals marginal cost, so that the equilibrium markup equals one. When firms have some market power, so that price is greater than marginal cost, we observe markups that are greater than one in equilibrium. Thus, in principle, the markup of price over marginal cost provide a simple way to measure the level of competition. However, in practice, given that marginal cost is itself not a well measured variable, the use of markups as a measure of competition has been limited.

Hall (1988) developed a simple way to estimate industry markup from the production function of firms. Relaxing the neoclassical assumptions of perfect competition and constant returns to scale, Hall showed that by estimating the parameters of a production function, we can interpret the coefficient associated with the weighted growth rate of labor as the

[5] Other such variables include total revenue over total cost (Roberts and Tybout, 1996) and entry threshold (Bresnahan and Reiss, 1991).

implied equilibrium markup. Based on his model, Levinsohn (1993) and Harrison (1994) showed that trade liberalization is associated with lower industry markups in Turkey and Cote D'Ivoire, respectively. Subsequent papers by Norrbin (1993), Roeger (1995), and Basu and Fernald (1997) update Hall's approach to account for the usage of intermediate input and returns to scale. To address endogeneity issues of Hall regressions which are also common across most production function estimations, Olley and Pakes (1996) use a polynomial of capital and investment as a control for the unobserved productivity. They show that such a nonparametric correction is successful in reducing the upward bias on the labor coefficient, without using instrumental variables that may be questionable. This is the approach taken by this paper.

In addition, we incorporate an industry markup function, derived from a short-run symmetric Cournot equilibrium, into a Hall-type regression in this paper. In a short-run symmetric Cournot equilibrium (that is, not allowing for entry), industry markups depend on the number of domestic firms, the share of imports in the domestic market, and the magnitude of total domestic sales. By introducing the industry markup function into the Hall regression directly, we are able to interpret the estimated coefficients associated with the resulting interaction terms between these variables and the weighted growth rate of labor per capital as the marginal effects of these variables on industry markups. In other words, we are able to directly estimate the *effects* of domestic and foreign competition on industry markups without explicitly estimating the industry markups themselves. This allows us to avoid some econometric complications arising from the use of an estimated dependent variable, and at the same time improve the efficiency and degrees of freedom of the estimations.

In the empirical model developed below the role of competition law is twofold. In the short-run, given a fixed number of domestic firms and import penetration, the introduction

of a competition law can be regarded as a structural change in the economy that may lower industry markups directly by shifting down the industry markup functions. However, in the long-run, when firms are free to enter and exit, a competition law may affect the number of domestic firms by enhancing the contestability of markets through facilitating entry (via enforcement of provisions regarding restrictive business practices, the abuse of dominant positions, the potential for creating such dominance through mergers, etc.). It is important to recognize that countries will have different incentives to adopt competition laws, depending on the competition environment that prevails in their industries. In the long-run, both the number of firms and the adoption of competition law is endogenous. This is taken into account in our estimations.

2.1 Hall Regression

For each country, let the output of industry i in period t be characterized by a production function of labor input, L_{it}, and capital input, K_{it},

$$Q_{it} = A_{it} F_i \left(L_{it}, K_{it} \right). \tag{1}$$

Differentiating Equation (1) with respect to time and dividing both sides by q_{it} yields the growth rate version of Equation (1):[6]

$$\hat{Q}_{it} = \hat{A}_{it} + \alpha_{iL} \hat{L}_{it} + \alpha_{iK} \hat{K}_{it}, \text{ where} \tag{2}$$

$$\alpha_{iL} = \frac{L_{it}}{F_{it}} \frac{\partial F_i}{\partial L_{it}}, \text{ and } \alpha_{iK} = \frac{K_{it}}{F_{it}} \frac{\partial F_i}{\partial K_{it}} \tag{3}$$

are the elasticity of output with respect to labor and capital inputs, respectively.[7]

[6] Here we adopt the convention to denote the growth rate of a variable with $\hat{}$:

$$\hat{X}_t \equiv \frac{\partial \ln X_t}{\partial t} = \frac{1}{X_t} \frac{\partial X_t}{\partial t}$$

For each industry i, assume that the production function F_i is homogeneous of degree S_i. F_i shows increasing, constant, or decreasing returns to scale with respect to all inputs when S_i is greater than, equal to, or less than unity. Subtracting the growth rate of the capital input from both sides of Equation (2) and applying Euler's theorem for homogeneous functions, we can re-express Equation (2) as:[8]

$$\hat{q}_{it} = \hat{A}_{it} + \alpha_{iL}\hat{l}_{it} + (S_i - 1)\,\hat{K}_{it}, \tag{5}$$

with the convention that $x = \frac{X}{K}$, (i.e., small caps express variables in per unit of capital terms).

Let

$$\mu_{it} = \frac{p_{it}}{c_{it}}, \tag{6}$$

be the price over marginal cost markup of industry i, and let θ_{itL} be the share of labor in total revenue. Given that $\alpha_{iL} = \mu_{it}\theta_{itL}$, Equation (5) becomes

$$\hat{q}_{it} = \hat{A}_{it} + \mu_{it}\left(\theta_{itL}\hat{l}_{it}\right) + (S_i - 1)\,\hat{K}_{it}. \tag{7}$$

Equation (7) can form the basis for estimation of industry markups by regressing the growth rate of value added per unit of capital on the weighted growth rate of labor per unit of capital and the growth rate of capital.[9]

As suggested by Basu and Fernald (1995), one may be concerned regarding empirical analyses that use the growth rate of real value added instead of the growth rate of real output, given that due to the construction of value-added statistics, the growth rate of real value added will not be independent of the growth rate of intermediate inputs if the market is not perfectly competitive (even when production functions are weakly separable). However, the UNIDO industry level data set only provides real output for a few countries. Thus, due to data constraints, we have to rely on real value added data rather than real output data.

[8] According to Euler's theorem, if a production $F_i\left(L_{it}, K_{it}\right)$ is homogeneous of degree S_i with respect to its inputs, then

$$\alpha_{iL} + \alpha_{iK} = S_i \tag{4}$$

[9] Note that while maintaining the assumption that α_{iL} and α_{iK} are parameters of the production function of industry i that are constant over time, we allow industry markup, μ_{it}, and labor share, θ_{itL} to vary. This is consistent with the empirical data, as we observe some fluctuation in θ_{itL} from year to year.

Complications arise when using Equation (7) due to the fact that productivity growth, $\hat{A}_{it}$, is unobservable. It is crucial to control for $\hat{A}_{it}$ since it enters the firm's first-order conditions for profit maximization that determine both input demand and output supply. Not controlling for $\hat{A}_{it}$ will bias upward the least squares estimates for the coefficients of the growth rate of labor per unit of capital and the growth rate of capital – a classical endogeneity problem.

Olley and Pakes (1996) develop an empirical strategy to control for the endogeneity problem. They introduce a polynomial of capital and investment as a control for the unobserved productivity. They assume that at the beginning of every period, firms know their productivity but this is not observable by the researcher. Based on the realized productivity, firms decide to stay in business or to exit. Providing that all surviving firms have positive investment, their investment can then be used as a control for productivity.[10] In other words, Olley and Pakes assume that firms with higher investment are those that realize higher productivity growth. They show that by introducing a polynomial of investment and capital stock as a control for productivity in the estimation of the production function, the upward bias on the coefficient of labor input is reduced.[11] Given that our analysis centers on industry markups (that is, the coefficient on labor input), getting consistent estimates of the labor coefficients is critical. We therefore adopt the Olley and Pakes correction and use a polynomial of capital and investment to control for the unobserved industry productivity growth.

[10]Levinsohn and Petrin (1999, 2000) show that instead of investment, intermediate input could be a good instrument for productivity growth, especially for those firms that stay in business but do not have positive investment every year.

[11]Olley and Pakes (1996) also discuss bias on the capital coefficient due to entry and exit behavior of firms, and use a selection model to control for it.

2.2 Markup Function

Leaving out time and industry subscripts for ease of exposition, assume that for each industry, domestic and foreign firms are Cournot players in the domestic market for a homogenous goods. Given homogeneity we assume further that there is a world market for the good and that imports can be characterized as being provided by one importing foreign firm, with a share in the domestic market of m. There are N identical domestic firms. Domestic firms face a positive fixed cost of entry, F, associated with government imposed entry and/or exit regulations of the type documented by Djankov et al (2002). Taking the quantity produced by other firms, Q_{-n}, as given, each domestic firm n chooses its output by maximizing its profits:

$$\pi_n^*(N, F, m) \equiv \max_{Q_n} \{ \quad \pi_n(Q_n, Q_{-n}) = p(Q) Q_n - c(Q_n) - F \}, \ \forall n = 1, ..., N,$$

where $p(Q)$ is the inverse demand function, $Q = Q_D + Q_M = \sum_{n=1}^{N} Q_n + Q_M$, Q_D is total domestic production (sales), and Q_M is the import quantity. (For simplicity, throughout what follows we assume that domestic firms do not export, so that domestic production equals domestic sales. In the empirical analysis below we take into account exports by domestic firms in the calculation of import market shares.) The first order condition for profit maximization implies:

$$p(Q)\left[1 - \frac{1}{\varepsilon}\frac{Q_n}{Q}\right] = c'(Q_n), \tag{8}$$

where $\varepsilon \equiv -(\partial Q/\partial p)(p/Q) \geq 0$ is the price elasticity of demand.

In a symmetric Cournot equilibrium, total domestic production is given by $Q_D^* = N\, Q_n^*$. Rearranging Equation (8) according to the definition of the markup in Equation (6) yields

$$\mu^* = \frac{1}{1 - \frac{1}{\varepsilon}\frac{1}{N}\left(\frac{Q_D^*}{Q_D^* + Q_M^*}\right)}.$$

Thus, the equilibrium markup in the domestic industry is inversely related to the magnitude of imports and the number of firms, while it is positively related to size of domestic production.[12] In addition, given the homogenous good assumption, the equilibrium price set by the domestic firms and the importer is identical, which means that the quantity ratio equals the volume ratio:

$$\frac{Q_D^*}{Q_D^* + Q_M^*} = \frac{p^* Q_D^*}{p^* Q_D^* + p^* Q_M^*} = \frac{1}{1+m},$$

where $m = \frac{p^* Q_M^*}{p^* Q_D^*}$ denotes the ratio of imports to domestic sales of the industry. Thus, given a fixed demand elasticity, industry markups are lower when there are more domestic firms and when the ratio of imports to domestic sales is larger:

$$\mu^*(\varepsilon, N, m) = \frac{1}{1 - \frac{1}{\varepsilon}\frac{1}{N}\frac{1}{1+m}}. \tag{9}$$

How effective are domestic and import competition in reducing industry markup, given the industry demand elasticity? Figure 1 plots industry markup against number of firms, given a hypothetical demand elasticity of 2 and an import ratio of 0.3. When there is only one domestic firm, the industry markup is about 1.6. The markup falls rapidly as the number of domestic firms increases, falling below 1.1 once there are more than 5 firms in the industry. With 30 firms or more, entry by an additional firm has only a negligible impact on the industry markup.

Similarly, Figure 2 plots industry markup against the ratio of imports to domestic sales, given a hypothetical demand elasticity of 2 and 10 firms in the industry. We again observe that imports reduce industry markups at a declining rate. Moving from zero imports to an import volume that equals sales by domestic firms, markups drop from 1.05 to 1.025. The markup of the industry drops below 1.1 once imports are more than 4 times the value of total domestic sales.

[12] See Jacquemin (1982) for a similar derivation.

Figure 1: Industry Markup vs. Number of Firms ($\varepsilon = 2$ & $m = 0.3$)

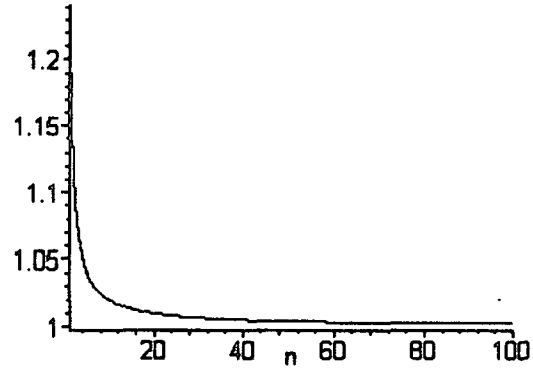


Figure 2: Industry Markup vs. Imports ($\varepsilon = 2$ & $N = 10$)

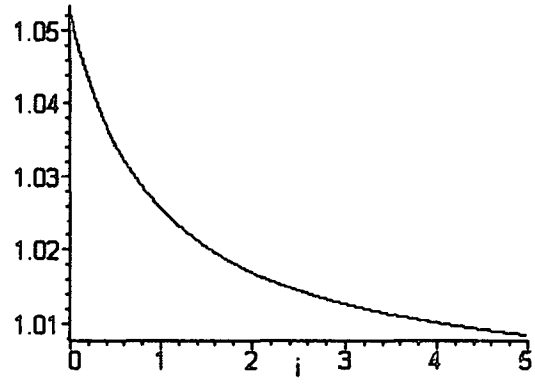
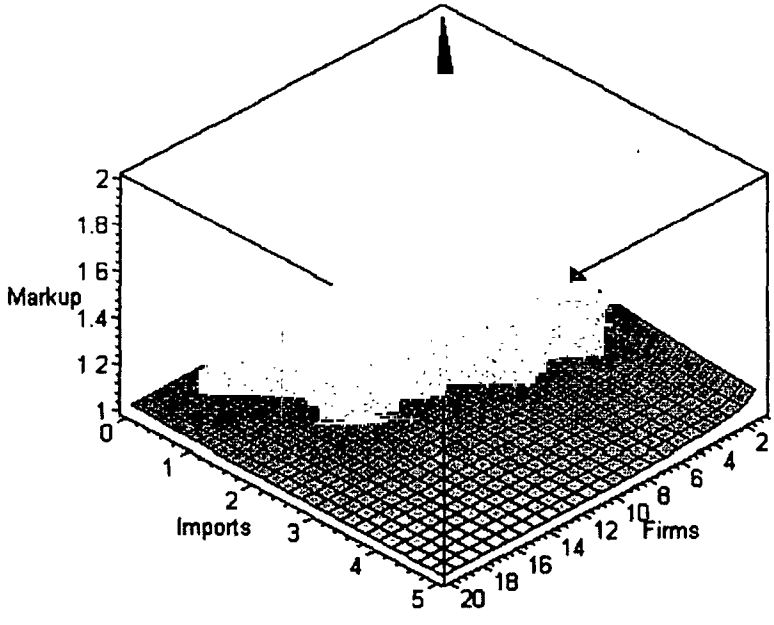


Figure 3 plots industry markup against the ratio of imports to domestic sales and the number of domestic firms, given a hypothetical demand elasticity of 2. Figure 3 clearly illustrates how import competition can act as a substitute for domestic competition when there are a limited number of domestic firms in the industry.

Figure 3: Industry Markup vs. Number of Firms and Imports ($\varepsilon = 2$)



Summing up, both domestic and import competition have larger effects on industry markup when the existing industry markup is higher, as can be expected in highly concentrated markets. If an existing industry is already near perfect competition, additional domestic firms (entry) or imports would have only minimal impact on markups. These findings are consistent with those of Bresnahan and Reiss (1991), where markets are shown to approximate a competitive one when there are 5 or more firms.

Equation (9) implies that industry markup is a non-linear function of the number of domestic firms and the share of imports in domestic sales. We therefore approximate the non-linear relationship with a second order semi-translog function:

$$\begin{aligned}\mu^*_{itc}(N,m;\mathbf{Z}) &= \beta+\beta_c+\beta_t+\beta_i+\beta_{NN}(\ln N_{itc})^2+\beta_N\ln N_{itc} \\ &\quad +\beta_{MM}(\ln m_{itc})^2+\beta_M\ln m_{itc}+\beta_{NM}\ln N_{itc}\ln m_{itc}+g(\mathbf{Z}), \qquad (10)\end{aligned}$$

where the demand elasticity of industry i in period t of country c is assumed to be the sum of country, time and industry fixed effects and matrix $\mathbf{Z}$ represents a set of controls which may help reduce the bias of the estimated coefficients. Variables in $\mathbf{Z}$ include the total value of domestic output and labor cost in each industry, GDP and GDP per capita of the economy.

2.3 Short-Run Empirical Model

We incorporate the industry markup function into the Hall regression by substituting Equation (10) into Equation (7) :

$$\begin{aligned}\hat{q}_{itc} &= C_c+C_i+C_t+P^5\left(\hat{K}_{itc},\hat{I}_{itc}\right)+[\beta+\beta_c+\beta_t+\beta_i+\beta_{NN}(\ln N_{itc})^2+\beta_N\ln N_{itc} \\ &\quad +\beta_{MM}(\ln m_{itc})^2+\beta_M\ln m_{itc}+\beta_{NM}\ln N_{itc}\ln m_{itc}+g(\mathbf{Z})]\left(\theta_{itL}\hat{l}_{it}\right), \qquad (11)\end{aligned}$$

where $P^5\left(\hat{K}_{itc},\hat{I}_{itc}\right)$ denotes the 5th order polynomial of capital and investment, and together with country-industry fixed effects and year fixed effects, are the controls for industry productivity growth.

Equation (11) shows that the coefficients of the interaction terms between the arguments of the semi-translog function and the weighted growth rate of labor, $\theta_{itL}\hat{l}_{it}$, can be interpreted as the marginal effects of those factors on industry markups. For example, the effect of a one percent increase in import penetration on industry markup and the effect of a one percent

increase in the number of domestic firms on industry markup would be respectively

$$\frac{\partial \mu^*_{itc}(N, m; \mathbf{Z})}{\partial \ln m_{itc}} = \frac{\partial \left(\partial \hat{q}_{itc} / \partial \theta_{itL} \hat{l}_{it} \right)}{\partial \ln m_{itc}} = \frac{\partial^2 \hat{q}_{itc}}{\partial \theta_{itL} \hat{l}_{it} \partial \ln m_{itc}} = \beta_M + 2\beta_{MM} \ln m_{itc} + \beta_{NM} \ln N_{itc},$$

$$\frac{\partial \mu^*_{itc}(N, m; \mathbf{Z})}{\partial \ln N_{itc}} = \frac{\partial \left(\partial \hat{q}_{itc} / \partial \theta_{itL} \hat{l}_{it} \right)}{\partial \ln N_{itc}} = \frac{\partial^2 \hat{q}_{itc}}{\partial \theta_{itL} \hat{l}_{it} \partial \ln N_{itc}} = \beta_N + 2\beta_{NN} \ln N_{itc} + \beta_{NM} \ln m_{itc}.$$

Thus, assuming that our application of the Olley and Pakes (1996) methodology is successful in correcting for the endogeneity of the regression errors, and that the current value of imports and number of firms are exogenous, the estimated coefficients of the interaction terms will be unbiased estimates of the effects of import penetration and domestic entry on industry markups. The theoretical model is considered to be not rejected by the data if the estimated values of both β_M and β_N are negative, while β_{MM}, β_{NN}, and β_{NM} are positive.

Finally, it is clear that even in the short-run, import penetration is likely to be endogenous. When there is a positive productivity shock or a favorable endowment shock, output of the industry may increase and reduce the import demand of that industry, given a fixed consumption pattern. While we already use the 5th degree polynomial of capital and investment to control for industry specific productivity shock, we have yet to control for endowment shocks. Following Trefler (1993) and Goldberg and Maggi (1999), we model the import penetration ratio as a function of factor shares in each industry/country, in addition to all the exogenous variables of the model ($\mathbf{W}$):

$$\ln m_{itc} = \delta + \delta_c + \delta_t + \delta_i + \delta_{fc} \text{factor\_share}_{itc} + h(\mathbf{W}). \tag{12}$$

Together, Equations (11) and (12) form a system of two equations to be simultaneously estimated to determine the short-run effects of imports and domestic competition (number of firms) on the level of industry markups.

Given this framework, we then consider the introduction of a competition law as a structural change to the economy, one that is expected to enhance competition between domestic

firms and reduce industry markups without specifying the channel. To test for whether competition law has this effect, we introduce a dummy variable, D_{tc}, in the markup equation, $\mu^*_{itc}(N, m; \mathbf{Z})$, which equals one if there is a competition law in the country in a given year. In other words, we run the following system of panel regressions:

$$\begin{aligned}\hat{q}_{itc} &= C_c + C_i + C_t + P^5\left(\hat{K}_{itc}, \hat{I}_{itc}\right) + [\beta_D D_{tc} + \beta + \beta_c + \beta_t + \beta_i + \beta_{NN}(\ln N_{itc})^2 \\ &\quad + \beta_N \ln N_{itc} + \beta_{MM}(\ln m_{itc})^2 + \beta_M \ln m_{itc} + \beta_{NM} \ln N_{itc} \ln m_{itc} \\ &\quad + g(\mathbf{Z})]\left(\theta_{itL}\hat{l}_{it}\right) \qquad (13)\end{aligned}$$

$$\ln m_{itc} = \delta + \delta_c + \delta_t + \delta_i + \delta_{fc}\,\text{factor\_share}_{itc} + h(\mathbb{W}). \qquad (14)$$

If the introduction of competition law has an effect on industry markup, we would expect the coefficients of the competition law dummy to be negative and statistically significant.

2.4 Long-Run Equilibrium and the Role of Competition Laws

In the short-run, it is reasonable to assume that the number of firms is fixed, and thus is exogenous to, among other variables, the industry markups and the policy environment. However, in the longer run, the number of firms is endogenous, a function of the profitability of the industry as well as the ease of entry. We capture the latter by a fixed cost, F in the model. Specifically, given a fixed cost of entry and the prevailing import share, the equilibrium number of firms is determined by the condition that the profit obtained by an additional firm is smaller than the fixed cost of entry:

$$N^*(F, m) = \arg\max\{0, \pi^*(N, F, m)\}.$$

As the number of domestic firms is a discrete variable, in equilibrium it is possible for all of the N^* existing firms to make a (small) positive profit.

A major role of competition law is to enhance the contestability of markets. Competition laws may affect the number of domestic firms in the long run by prohibiting anti-competitive behavior that raises entry costs. This suggests that the existence of a competition law should, *ceteris paribus*, lead to a higher number of domestic firms. To the extent that the number of domestic firms affects industry markup, competition law would then *indirectly* affect markups.[13]

On the other hand, in the long-run (that is, allowing for entry and exit), there may also be a country 'self-selection' effect in that the adoption of competition law is a function of the overall level of competition prevailing in an economy. Specifically, if the industry import penetration ratio is high, or there is a large enough number of domestic firms in each industry, the need to establish a competition law is less, controlling for the stage of development and size of the countries. Conversely, if there is a small number of domestic firms, it may be politically more difficult for countries to set up a competition law as the incentive for firms to lobby against such a law will be higher. Overall, the impact of domestic market structure on the probability for countries to adopt a competition law is therefore an empirical question. Both entry and the decision by governments to adopt competition laws are endogenous in the long-run.

Estimating the long-run effect of competition law on domestic industry markup via its effects on the number of domestic firms thus requires estimation of a self-selection model, where domestic entry depends in part on the existence of competition law, conditioned on countries developing a competition law. Specifically, we test the following two-step model

[13]We recognize that in practice the enforcement of competition law may be such as to raise the costs of entry for new efficient entrants. This type of capture of competition enforcement by incumbents, as well as enforcement mistakes that conclude that active price competition is predatory, would lead to an opposite conclusion. The empirical analysis that follows can be seen as providing a test of the hypothesized effect of competition law on the number of firms in an industry.

for the long-run equilibrium:

$$\ln N_{it+1c} = \gamma_D D_{tc} + \gamma_\lambda \lambda_{tc} + f(\mathbb{X}) \tag{15}$$

$$D_{tc} = \begin{cases} 0 \text{ if } D\left(\bar{N}_{tc}, \bar{m}_{tc}; \omega\right) \leq 0 \\ 1 \text{ if } D\left(\bar{N}_{tc}, \bar{m}_{tc}; \omega\right) > 0 \end{cases}, \tag{16}$$

where λ_{tc} is the estimated hazard rate of the country adopting a competition law in year t, based on the first step selection model which specifies the decision rules of the government. Without controlling for λ, the estimated treatment effect of adopting a competition law, γ_D, is likely to be biased and inconsistent. Note that the dependent variable of the second step regression, Equation (15), is the one period lead value of the number of domestic firms. This captures the effect of a competition law on domestic entry, since in the short-run, entry-related fixed costs are likely to keep the current period number of firms constant. On the other hand, Equation (16) specifies the decision making process of the government, which depends on the *average* industry characteristics, such as the current number of firms and import penetration. Both X and ω are the matrix of control variables in the two-step model.

3. Data

Our data set comprises 28 industries in 42 developed and developing countries for 18 years (1981-1998). Industries are defined at the 3 digit level of the International Standard Industrial Classification (ISIC). The total number of observations in the data set is only 11,484, due to missing values for either industries, countries or years. Industry level production and trade data (exports and imports) are obtained from UNIDO and the Trade and Production Database compiled by Nicita and Olarreaga (2002).[14] We utilize World Bank (2002) for country level data on variables such as GDP and GDP per capita. Information on the existence and year of adoption of competition legislation is drawn from national sources and

[14] As noted earlier, we use export data to calculate import shares in total sales.

the OECD. Table 1 reports sample averages of the key variables used in the regressions by country.

Countries and industries in our data set vary quite significantly. On average, each industry in each country has some 1,500 firms, ranging from less than 50 firms on average in each industry in Panama to more than 15,000 firms on average in a Japanese industry. The size of industries also varies substantially across countries – with average sales of US$70 million, Cyprus has the smallest average industry size, while at nearly US$90 billion, industries in the U.S. are the largest.

Import competition is weakest in Japan, where the ratio of imports to domestic production for a typical industry is only 6 percent, compared to 80 percent for a typical industry in Hong Kong. On average, the ratio of imports to domestic output is around 18 percent in the sample. In terms of the year in which competition law was first passed, Canada and U.S. have long-standing enforcement dating back to the turn of last century, while Egypt, Hong Kong and Singapore have yet to adopt any form of competition law. Nineteen countries in the data set had a competition law prior to 1981. A number of developing and transitional economies subsequently adopted competition laws during the sample period.

Table 1 also presents data on GDP and GDP per capita for the countries in the data set. Here again there is substantial variation. The largest country in the sample, the U.S., is more than 1000 times larger than Jordan, the smallest country in the sample. On the other hand, the richest country in the sample is Japan, with a per capita GDP more than 100 times greater than the poorest countries (India and Kenya).

Table 2 provides sample averages of the main variables used by industry. The food industry has the largest average number of firms, with an average of more than 5200 firms in each country. On the other hand, with an average of only 33 firms, the petroleum refining

industry is the most concentrated. The largest industry in the sample is the transport equipment industry, with average sales of more than US$20 billion. The pottery and earthware industry lies at the other end of the spectrum with average sales of only US$550 million per year. Firms in the petroleum industry on average are the largest in size - the typical firm has average sales of US$275 million a year. On the other hand, the footloose apparel industry has the smallest average firm size – only about US$1 million on average.

In terms of total volume of imports (trade), machinery and transport equipment industries rank first. However, judging by the ratio of imports to domestic production, leather products, scientific instruments and miscellaneous manufactures face the most intense import competition. With an import ratio of only 4 percent, the printing and publishing industry faces the least import competition.

Given the heterogeneity of the countries and industries in the data set, it is clearly important to control for country and industry specific effects in the estimation of the industry markup function. We also include year specific effects to control for any general movement of international prices and development trends.

4. Results

Table 3 presents the regression results for the short-run case, where the number of domestic firms is assumed to be fixed. The dependent variable is the growth rate of real industry value added relative to the capital stock, $\hat{q}_{itc}$. The top part of Table 3 presents the estimated semi-translog function, $\mu^*_{itc}(\varepsilon_{itc}, N_{itc}, m_{itc})$, as defined in Equation (10).

Column (1) shows the baseline ordinary least squares regression using the full sample, without a competition law dummy variable. The estimated first order effect of imports on industry markup is negative and significant; the same holds for the estimated coefficient on

domestic sales. The second order effects of these variables do not seem to matter in the full sample. On the other hand, we do not find the effect of the number of domestic firms on industry markups to be significant. This is not surprising, as in the full sample the average number of firms per industry is around 1,500. Thus, an additional firm in an industry should not have any significant effect. As shown in Figure 1 and Bresnahan and Reiss (1991), entry by new firms should have the greatest effects on competition when the existing market is highly concentrated. We will come back to this point later.

The lower part of Table 3 reports the variables that pertain to the industry production function, including a 5th order polynomial of capital and investment to control of industry productivity growth and a full set of industry, year and country fixed effects. The estimated coefficients are not reported due to space limitations, but are available upon request.

The competition law dummy variable representing the structural change due to the adoption of a competition law is introduced in Column (2). Not only is the dummy variable not significant, it is clear that adding the competition dummy does not change the previous result. In other words, we do not observe a significant effect of the competition law dummy variable on industry markups in the full sample – the primary policy-determined variable is foreign competition.

Given that the impact of both foreign and domestic competition on markups is most likely to be important in concentrated markets, the next two columns of Table 3 report the results of a three-stage least squares regression for a subset of industries with high concentration, specifically, those with no more than 30 domestic firms. Both the production and import penetration functions are simultaneously estimated. Column (3) reports the results of the production function estimation, and Column (3') reports those for the import penetration function.

Column (3) indicates that for this sub-sample *both* imports and the number of domestic firms have a statistically significant effect in reducing industry markups. In fact, the marginal effect of a 10 percent increase in the import share in domestic sales is quantitatively equivalent to the marginal effect of an additional domestic entrant when there are only 9 firms in the market. In other words, the regression results suggest that both foreign and domestic competition are important in reducing domestic market power. Domestic sales and labor costs are also significant determinants of industry markups - a larger domestic market or lower cost of production are associated with higher industry markups.

Column (3') reveals that it is important to control for the endogeneity of import penetration (Equation (14) above). Factors that are negatively correlated with import penetration include the number of domestic firms and their sales, and the size of the overall economy. The effects of domestic endowments, proxied by the industry factor shares are also included in the regression, but coefficient estimates are not reported in the Table due to space limitations.

The effects of adding the competition law dummy to the system of equations are reported in column (4). Once again, we find that after controlling for the effects of domestic and foreign competition, the direct effect of competition law is not statistically significant, although it has the right sign, even if the analysis is restricted to more concentrated industries with less than 30 firms.

Table 4 presents results for the long-run equilibrium case, where both competition law and the entry and exit of domestic firms are endogenous. The number of domestic firms in an industry is responsive to, among other factors, the (fixed) cost of entry, which in turn is affected by the competition law of the countries. On the other hand, the government's decision to adopt a competition law may depend on the average level of competition in domestic industries, as well as the stage of development of the economy (proxied by GDP and

GDP per capita). This suggests that the *'treatment effect'* of competition law on domestic competition could be underestimated if we do not control for the self-selection bias.[15]

To correct for the endogeneity of competition law, we use a two-step procedure developed by Heckman (1979). Specifically, assume that for any period, a country's decision to adopt or abandon a competition law depends on the perceived level of industry markups, which are affected by the current level of imports, total domestic output, and total number of firms in the industry. We then first estimate a selection model by regressing the competition law dummy on average industry imports, domestic sales, and the number of firms, controlling for level of GDP and GDP per capita of the countries (Equation (16) above). We use the predict probability to construct the hazard rate, λ_{tc}, which will then be included in our entry regression (Equation (15)). We expect the estimated hazard rate to be negatively correlated with domestic entry, since the larger the number of domestic firms, the less likely the government would need to adopt a competition law to promote entry. Once the self-selection bias is controlled for by the estimated hazard rate, we expect the competition law dummy variable to have a positive effect in promoting entry (that is, the future (t+1) number of firms in each industry).

Table 4 presents the results of the two-step selection model, where Column (1) shows the estimated effects of competition law and the self-selection bias on domestic entry, and Column (2) shows the estimated decision rule of governments in adopting competition laws.

The regression results suggest self-selection bias is indeed important. Correcting for this bias, industries operating under a competition law tend to have a larger number of domestic

[15]Specifically, while some countries may choose to pass and keep a competition law as a response to current high industry markups, others may not need such a law given low industry markups. This would lead to a contemporaneous positive correlation between industry markup and the status of the competition law. Not controlling for such a self-selection bias will lead to under-estimation of the effectiveness of competition law in reducing industry markups. In other words, given that we expect the treatment effect of competition law on industry markup to be negative, the least squares estimate would have an upward bias; if the bias is large enough it could result in a positive estimate.

firms – on average 7.2 percent more. Moreover, countries' decisions to adopt competition laws do appear to be associated with variables that reflect the average level of competition in industries. For example, countries that have a higher level of import penetration are less likely to adopt competition laws, while countries that have a higher level of domestic sales in a typical industry are more likely to adopt competition laws.

The results in Tables 3 and 4 together suggest that while competition law may not have a direct effect on industry markups, even in more concentrated markets, it may affect industry markups in the long run via its effects on domestic entry and thus the long run equilibrium number of domestic firms.

5. Conclusion

For competition law to be a priority, it must yield a higher pay-off in terms of fostering competition than other policy options. The analysis in this paper suggests that dealing with trade barriers and government regulation that restrict domestic competition by impeding entry and exit by firms will generate a higher rate of return than the adoption of a competition law. Indeed, the regression results obtained here suggest that the direct effect of competition law on industry markup is not significant, even if the analysis is limited to the sub-sample of more concentrated industries. However, once account is taken of the endogeneity of competition law adoption, we find that competition laws have an effect on entry by domestic firms, which may indirectly affect the long run level of industry competition (markups).[16]

Any assessment of whether and how to adopt antitrust disciplines must of course consider factors that have been ignored in this paper. One such factor relates to the costs of

[16]Some authors have found that competition policy paradoxically reduces the number of firms-see e.g., Bittlingmayer (1985)-because prohibitions on price fixing and similar arrangements among firms encourage mergers. Our cross-country results suggest that while such incentives may exist the overall effect is the opposite.

enforcement. Import liberalization not only has a more powerful and direct effect on competition, it also is a lower cost policy alternative, especially in the long run given no recurrent administrative enforcement and compliance costs. Another factor not considered here are possible international externalities associated with the enforcement (or non-enforcement) of antitrust by foreign countries. It must also be recognized that the analysis has been limited to industries producing tradable goods. Many products are non-tradable (e.g., many services). Even if tradable, competition may be limited to local markets for other reasons (e.g., transport costs). Certain products may be produced by (natural) monopolies or by firms where 'unnatural' (government-made) barriers to entry restrict contestability. In determining whether to make the adoption and enforcement of competition law a domestic priority, a wider focus will be required. However, it should also be recognized that in many cases competition law may not be the appropriate instrument to deal with such issues either. For example, in the case of services it may well be the case that the impact of government policies that restrict competition in services dominate (or are a major element allowing) private restrictive business practices.

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Table 1: Data at a Glance by Country, 1981-1998

Country	Numbers of		Value in Million of US$			US$	Comp. Law	Growth Rates (%) of			
	Sample[1]	Firms	Imports	Domestic Production	GDP	GDPPC	Passed in	Y/K	L/K	K	I
Australia	138	1008	742	2830	248000	16146	1906	-0.34	-1.28	0.41	-1.09
Austria	392	313	1120	2380	195300	25362	1951	-1.88	-2.67	3.19	-0.02
Bulgaria	60	577	86.9	286	12570	1485	1991	-47.46	-19.31	44.69	57.70
Canada	276	1325	2660	8260	468100	17841	1889	-2.93	-2.50	4.56	2.70
Chile	376	55	265	839	42260	3180	1959	-1.02	-1.53	6.91	6.20
Colombia	402	271	213	798	69710	2050	1959	-0.59	-0.63	3.92	-3.31
Cyprus	335	278	74.2	70	6049	8978	1989	-4.01	-2.20	6.56	-2.46
Denmark	297	381	707	1300	150000	29267	1937	-0.31	-0.61	2.22	3.08
Egypt	366	268	268	786	45400	907	No Law	4.12	-0.34	3.85	5.13
Finland	454	337	577	2020	116500	23419	1958	-0.96	-1.93	1.69	1.80
Greece	336	294	407	797	102200	10210	1977	1.35	-0.69	-0.08	-3.69
Hong Kong	350	2042	6660	1610	106700	18265	No Law	-8.99	-6.23	4.58	-10.30
Hungary	351	199	27.5	876	48150	4588	1990	-3.23	-2.23	0.19	-3.38
India	462	3846	553	4410	271600	320	1969	-5.36	-4.53	12.66	8.78
Indonesia	365	570	626	1430	129600	737	1999	-6.28	-3.47	23.83	15.18
Ireland	257	194	412	801	40790	11605	1991	-2.05	-2.62	2.43	-0.37
Italy	330	1266	3820	13300	959700	16919	1990	-4.86	-3.37	5.34	1.03
Japan	471	15044	4830	73500	4452000	36206	1947	-1.37	-1.27	2.85	2.90
Jordan	325	424	99.7	109	5339	1603	2000	1.19	-0.51	6.29	-7.59
Kenya	91	198	97.7	480	9283	333	1988	-41.42	-19.26	43.90	16.96
Korea	494	2397	1930	8490	333900	7704	1980	-1.89	-2.81	9.96	8.27
Mexico	252	111	679	1870	246900	3180	1992	-4.06	-1.95	8.35	1.01
Morocco	209	282	217	586	34130	1317	1999	0.29	-0.56	4.50	3.10
Netherlands	208	327	3420	5150	340700	22943	1957	-1.59	-2.96	3.99	4.59
New Zealand	80	843	385	974	51500	15370	1986	-5.14	-3.03	0.36	-14.09
Norway	433	283	761	1530	122200	28823	1926	2.34	-1.11	-0.01	-1.14
Pakistan	82	163	183	421	39590	402	1970	-25.27	-8.38	36.04	-8.25
Panama	146	45	51.4	89.2	6784	2733	1996	-6.91	-4.28	7.36	9.28
Peru	295	522	82.4	498	48420	2394	1991	-2.01	0.26	-1.63	-19.62
Poland	190	216	318	1870	105900	2800	1990	-25.60	-5.65	12.15	-1.09
Portugal	241	488	322	725	77670	7799	1983	-5.07	-2.52	4.26	0.88
Romania	17	656	145	716	30250	1320	1991	-64.40	-18.42	43.11	18.83
Singapore	406	156	2120	1430	54550	19848	No Law	-3.31	-3.00	6.67	5.01
Spain	386	5380	1800	6900	477000	12340	1963	-6.62	-3.14	6.12	3.96
Sri Lanka	253	294	93.9	99.9	10030	593	1987	-2.01	-2.34	13.07	-0.17
Sweden	168	383	953	2530	197400	23641	1953	0.32	-1.30	0.68	0.82
Thailand	77	537	1430	3570	128900	2258	1979	0.50	-5.42	38.78	-13.69
Turkey	196	274	608	2610	148500	2607	1994	-22.39	-6.75	30.18	6.09
United Kingdom	417	5026	5740	16900	969600	16881	1948	-1.79	-2.13	0.98	0.62
United States	84	13952	12400	88100	5716000	23456	1890	2.14	-0.68	1.16	-0.15
Venezuela	416	360	303	1030	66710	3508	1991	-1.59	-1.01	3.98	-1.34
Average	11484	1502	1419	6414	406973	10520	1970	-7.33	-3.76	10.00	2.25

Notes: [1] Denotes the total number of observations for each country.

Unless otherwise stated all numbers denote simple averages across industries and years for each country.

Table 2: Data at a Glance by Industry, 1981-1998

ISIC		Numbers of		Value in Million of US$		Growth Rates (%) of			
Industry	Description	Sample[1]	Firms	Imports	Domestic Production	Y/K	L/K	K	I
311	Food	455	5244	2660	18800	-1.39	-1.53	6.16	2.61
313	Beverages	417	508	307	3700	-3.24	-1.67	6.86	0.87
314	Tobacco	402	383	222	1850	-2.47	-1.67	7.47	1.29
321	Textiles	455	3414	1970	6620	-3.32	-2.30	2.98	-1.85
322	Apparel	442	2702	1150	3030	-3.32	-2.81	7.01	2.36
323	Leather products	405	441	503	702	-3.53	-2.41	3.28	-2.18
324	Footwear	422	426	318	798	-5.73	-3.93	5.70	-2.61
331	Wood products	426	2826	696	3180	-3.22	-1.99	4.43	-1.93
332	Furniture	427	1655	254	1980	-3.17	-2.38	6.53	1.99
341	Paper and products	453	892	974	5480	-4.17	-2.52	6.66	-0.28
342	Printing and publishing	450	3337	249	6650	-4.49	-3.39	9.07	5.37
351	Industrial chemicals	394	414	2960	8580	-1.16	-1.47	5.20	0.05
352	Other chemicals	405	829	1340	7560	-3.05	-2.36	8.63	4.62
353	Petroleum refineries	311	33	1400	9020	-6.31	-2.35	7.88	-1.31
354	Petroleum and coal products	238	174	112	1090	-5.11	-2.45	8.26	2.26
355	Rubber products	435	412	308	1890	-4.02	-2.54	5.13	2.29
356	Plastic products	437	1763	774	5050	-4.02	-2.30	9.34	5.31
361	Pottery and earthenware	356	346	82.4	550	-5.28	-3.98	6.91	-1.20
362	Glass and products	376	233	223	1240	-5.95	-3.71	8.55	0.74
369	Non-metallic mineral products	411	1935	241	4650	-3.77	-2.21	7.20	2.63
371	Iron and steel	374	764	1360	9870	-3.51	-2.59	3.55	-2.02
372	Non-ferrous metals	371	425	1280	3940	-3.14	-2.13	5.43	2.03
381	Fabricated metal products	451	4757	1380	9280	-3.68	-2.46	6.42	1.02
382	Machinery except electrical	418	4903	5640	19100	-1.97	-2.39	7.51	1.08
383	Electrical machinery	451	2415	5340	18500	-3.81	-2.75	7.20	3.59
384	Transport equipment	451	1374	4660	20500	-3.25	-3.53	6.82	3.27
385	Scientific equipment	411	707	1650	2820	-3.96	-3.00	8.90	3.02
390	Other manufactured products	440	1530	1220	2100	-5.33	-3.31	7.98	2.28

Notes: [1] Denotes the total number of observations in each industry.

Unless otherwise stated all numbers denote simple averages across countries and years of each industry

Table 3: Regression Results

Explanatory Variables (in log)	OLS (1)	OLS (2)	3SLS (3)	3SLS (3')	3SLS (4)	3SLS (4')
Competition law		0.420			-0.146	
		(0.244)			(0.201)	
Imports	-0.223**	-0.232**	-0.139**		-0.136**	
	(0.107)	(0.107)	(0 064)		(0.064)	
Imports squared	-0.002	-0.002				
	(0.009)	(0.009)				
Firms	0.372	0 370	-0.138***	-0.544***	-0 140**	-0 543***
	(0.213)	(0 213)	(0 052)	(0.149)	(0.052)	(0.149)
Firms squared	-0.025	-0.025	0 006***	0.159***	0.006***	0.159***
	(0.018)	(0.018)	(0 002)	(0.032)	(0.002)	(0.032)
Firms * Imports	0.030	0.032				
	(0.018)	(0.018)				
Sales	-1.056**	-1.133**	2 304***	-2 692***	2 320***	-2.692***
	(0.486)	(0.482)	(0.657)	(0.341)	(0.657)	(0.341)
Sales squared	0.024	0 026**	-0.076***	0.051***	-0.077***	0 051***
	(0.013)	(0.013)	(0.018)	(0 010)	(0.018)	(0.010)
Labor cost	-0.258	-0 597	-3 375***	0 427	-3.458	0 428
	(0.959)	(0.983)	(0.999)	(0.418)	(1.006)	(0.418)
Labor cost squared	0.015	0.034	0.199***	-0.046*	0 205***	-0.046*
	(0 058)	(0.060)	(0.056)	(0.025)	(0.057)	(0.025)
GDP	3 054**	3.790**		-2 939***		-2.940***
	(1 051)	(1.496)		(0.610)		(0.610)
GDPPC	-1.298	-1 878		4.142***		4.142***
	(1 504)	(1.502)		(0.552)		(0.552)
Constant	-54.393**	-66.330**	-1.126	71 319***	-0.950	71.342***
	(27.209)	(26.882)	(7.185)	(12.344)	(7.188)	(12.344)
Factor shares				Yes		Yes
Industry Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Country Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Polynomial (K,l)	5th order	5th order	5th order		5th order	
Industry Fixed Effects	Yes	Yes	Yes		Yes	
Year Fixed Effects	Yes	Yes	Yes		Yes	
Country Fixed Effects	Yes	Yes	Yes		Yes	
Sample Size	10447	10447	1488	1488	1488	1488
R-squares	0.4219	0.4222	0.3499	0.9601	0.3501	0.9601

notes: Column (1) and (2) are performed using the full sample.
Column (3) and (4) only use data on the highly concentrated markets (firms<=30).
Both sets of 3SLS estimating a system of 2 equations on industry markups and import penetration.
Column (3') and (4') report results of the import penetration regression where factor shares are used as controls for endowments and productivity differences.

Table 4: Selection Models

Dependent Variable: Firms in next period	(1)	Dependent Variable: Competition Law	(2)
Competition law	0.072**	Average imports	-1.185***
	(0 017)		(0.055)
Lambda (hazard rate)	-0.066***	Average imports squared	-0.128***
	(0.009)		(0.008)
Imports	-0.002	Average firms	-0.201
	(0.002)		(0.488)
Sales	0.023***	Average firms squared	-0.067
	(0.005)		(0.047)
Labor cost	-0.025**	Average lagged firms	4.392***
	(0.010)		(0.536)
GDP	-0.525***	Average lagged firms squared	-0.334***
	(0.074)		(0.052)
GDPPC	0.311***	Average sales	2.814**
	(0.078)		(1.260)
Firms	0.891***	Average sales squared	-0.096***
	(0.010)		(0.031)
Lag firms	0.066***	Competition agency[1]	4.317***
	(0.010)		(0.132)
Year	0.015***	GDP	-4.349**
	(0.002)		(1.743)
Constant	-18.363***	GDP squares	0.101***
	(4.342)		(0.035)
		GDPPC	-8.553***
			(0.379)
		GDPPC squared	0.576***
Industry Fixed Effects	Yes		(0.023)
Year Fixed Effects	Yes		
Country Fixed Effects	Yes	Year	0.127***
Sample Size	8277		(0.008)

Notes: Heckman two step selection model is performed.
Column (2) reports the competition law selection model and Column (1) reports the domestic entry model, controlling for selection bias (lambda) estimated from Column (2
[1] Dummy variable which equals one if the country has a competition agency in that year.

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